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## CANUSA-East Demo Tour

The last week in July brought together a diverse group of CANUSA cooperators, Washington Office personnel, State and Private Forestry people, and New England foresters for a tour of demonstration areas in upstate New York and Vermont. Doug Allen, State University of New York at Syracuse, hosted the first 2 days' visit; Brent Teillon, of Vermont's Division of Forestry, guided the troops through the spruce-fir/hardwood uplands of his State's Northeast Kingdom. The purpose of the trip was to familiarize us[1] with the operational use of pheromone-baited traps for monitoring budworm moth populations and a pilot test of *Bacillus thuringiensis* (B.t.) formulations for spruce budworm control. We also took the opportunity to see CANUSA-sponsored studies of the effects of predator exclusion on budworm populations. Management from the eastern component, which organized the trip, also hoped that the local observers would get a better feel for what the CANUSA Program is all about. We knew this objective was going over well when our trip made the 6 o'clock news in Vermont, but more about that later.

Tuesday, July 27. The core travelers arrived at the Syracuse airport around lunchtime and were met by Doug Allen and his crew from SUNY. They ferried us to the Tug Hill Experimental Forest, for a look at spruce budworm pheromone traps used in spruce plantations. Doug described the trap presently utilized as a modification of the Michigan State University trap developed by Ring Cardé. It is now called the "covered funnel trap" — possibly because Ring has moved to the University of Massachusetts. The trap features a plastic dinner plate inverted over a plastic funnel that contains a chip impregnated with the spruce budworm pheromone and an insecticide strip with dichlorvos. Male budworm moths make a beeline for the pheromone source, succumb to the pesticide vapors instead, and tumble into the bottom of the funnel. Field crews remove the moths at regular intervals during the trapping season (late June through the first week in August). Carl Palm, working for Doug on this project, stated that their team was surprised to find rather large body counts in stands where little or no evidence of spruce budworm activity could be spotted.

Doug described this work as an effort to demonstrate the operational use of two pheromone formulations to monitor budworm populations. State personnel, he stressed, will be able to check on budworm levels at a reasonable budget for equipment and field personnel. Next, Doug's caravan headed northeast to the New York State Ranger School in Wanakena. We arrived late in the afternoon, and most of the travelers (not including the author) headed straight for the woods to hear a discussion of the local impacts of saddled prominent and associated insects of northern hardwoods. Doug's population dynamics/pheromone work is also going on at selected plots on land owned by the Ranger School. After dinner, we heard faculty members describe the school's 1-year forestry technician program. It annually turns out about 90 students, who are prepared in a rigorous, hands-on curriculum including harvesting, mensuration work, tree identification, and a variety of "dirt forestry" subjects. Some graduates go on to 4-year forestry schools, where, according to Doug, they are always superior to the ordinary undergrad students. Others completing the Wanakena course go right to work for major industrial landowners in New England. One faculty member told me that their grads were having more trouble than usual in finding employment due to the depressed lumber market. Reflecting this situation, the school's enrollment has dropped to just a full complement of students; in former years, applicants were put on a 1- or 2-year waiting list to enter.

Tuesday night we stayed as guests at the Ranger School, and despite the next morning's rain, we enjoyed the beautiful lake and rolling hills of the area. For those of you following the acid precipitation controversy in the Adirondacks, I questioned a faculty member about the situation. It is true that their lake is acidic, but he attributed this as much to the mineral character of lakeside rocks as to the encroachment of acidic pollution from elsewhere. So far, there have been no significant fish kills in the area.

Wednesday, July 28. In a steady downpour our vans pressed on to the Adirondack Ecological Center in the Huntington Memorial Forest, Newcomb, New York. At the Center, State of New York personnel described the Huntington Forest, which was created in the 1930's as a bequest for the perpetual study of wildlife habitat in the upstate area. The forest is mainly spruce-fir and mixed hardwoods with emphasis on American beech. Beeches have been hard hit by beech bark disease, and Center researchers would like to regenerate cutover stands with other hardwood species to avoid the disease in the future.

Spruce budworm is endemic in the Huntington Forest, and one of CANUSA-West's experiments studying low-level populations has been translocated to the area for replication. Kevin Hosman, an investigator working for Bob Campbell in Oregon, is replicating the western experiments on exclusion of birds and ants and resulting changes in spruce budworm population survival.

[1] Attendees included Mel McKnight, Dave Grimble, Dennis Souto, Bob Blomquist, Hal Marx, Dan Kucera, Tom Schenarts, Bruce Montgomery, Bob Taylor, Janet Searcy, and a floating cast of grad students, loggers, small-woodlot owners, consulting foresters, and natural resources personnel from both venues.

The director of the Adirondack Ecological Center also described for us their bobcat surveys. An ongoing project is county-by-county recording of sitings of bobcats all over the State, and the cats are surprisingly well distributed. The Center is investigating their role in the ecosystem, with an eye to eventual management recommendations that may include hunting seasons for bobcat in New York.

With rain continuing, we left after lunch on the 4-hour drive to Morrisville, Vermont. Our route took us down out of the Adirondacks, over Lake Champlain at Port Henry, and into the rolling but populous hills of Mel McKnight's home State. Near Stowe, I spotted a sign tacked onto a barn door: Wild Turkey Reporting Station. This was our first evidence of Vermont's interest in wildlife populations, and later that evening the theme recurred in Bill Sladyk's talk about the State's deer management programs. Although Vermont does not have an extensive pulp market for spruce-fir, the State is interested in this conifer type — and by extension, in spruce budworm — because of the forest's influence on the local deer herd.

During the summer, white-tailed deer nibble all sorts of hardwood browse — branch tips, bark, and so forth. In the winter, when snows reach several feet, the deer cannot easily find food in hardwood forest stands. Deciduous trees have lost their leaves, and nothing stops the snow from reaching the forest floor. In spruce-fir stands, however, the evergreen needles support quite a share of the snow load, and the floor is much less deeply covered. Deer take cover in the spruce-fir stands, where they can get around more easily to forage for food. Enter the spruce budworm as a factor in the equation. If budworms have badly hit a coniferous stand, its ability to shelter deer is compromised because there aren't enough needles left to block the snowfall. When deer can't find shelter and food, the results are obvious.

Vermont takes annual dead-deer surveys in the known "deer yards" — coniferous stands with suitable winter habitat. By examining the bone marrow in the found carcasses, State personnel can tell how healthy the resident deer herd really is. And, unfortunately, the herd is none too healthy. Bill showed us color slides of nimble-looking deer but cautioned us that their appearance was misleading. When the weather is cold, they fluff out their hair for better insulation; thus, they look fat and unmarked when in reality they are often badly malnourished. Bill's dead-deer bone-marrow studies have revealed that many Vermont deer are starving to death. To the extent that spruce budworm lessens the ability of spruce-fir stands to provide winter cover in Vermont, and local deer are threatened with starvation, Vermont's wildlife habitat program is interested in budworm. Bill joined the tour for our 2 days in the Vermont woods, and it turned out that one of the B.t. plots we visited Thursday was in a deer yard that he had surveyed last winter.

Thursday, July 29. From our base in Morrisville, we drove 32 km (20 miles) into the country to visit three plots in the 1982 Vermont B.t. experiment. The weather refused to cooperate: rain continued off and on all day, but at least this helped keep the deerflies down. Brent Teillon played host for this section of the tour, taking us first to the Greensboro trailer headquarters for the entire experiment, set up on the open woodlands of the Withers family. We did not meet the 87-year-old head of the family, but his son, Waylon, joined us in discussing the local timber situation and the history of the property.

The B.t. plots we saw are located on second-growth spruce-fir woodlands that have experienced budworm damage only in recent years. The Witherses make their living with two sugarbushes on their property and are not presently logging spruce-fir from their lands. But they are concerned, like many of their neighbors, that the spruce budworm may get a firm foothold in Vermont. Deer hunting, a popular sport among Vermonters as well as out-of-State visitors, would be compromised if the spruce-fir resource should go unprotected.

We found Vermont people to be very ecology-conscious and reluctant to get into the business of spraying chemical insecticides. They were very interested in our B.t. experiments, though. So were the local media. Channel 3, WCAX-TV Burlington-Plattsburg, sent out a reporter to cover the demonstration tour for the evening news. Bob Taylor and Mel McKnight appeared on the 6 p.m. segment, but ironically we were not back from the field in time to see it. The show was repeated at 11 p.m. but edited down to record Bob's question-and-answer session only.

On this part of the tour we were taken to three typical spruce-fir sites, a check plot with ample budworm damage and no treatment, a plot where B.t. had been applied with variable control, and a plot where B.t. had given good control of the budworm, evidenced by minimal defoliation. These plots were chosen from the 30 Caledonia County test sites, each of which covers 12.1 ha (30 acres) and carries primarily spruce-fir.

Ownership patterns in Vermont are much different than in Maine: the Vermont sites are owned by various individuals, often absentee landlords holding the property for long-term investment, not spruce-fir production. One plot is on land owned by a Venezuelan. The checkerboard pattern of ownership poses problems for anyone interested in mounting a control effort — State pest control specialists, small landowners, managers of parks or publicly owned forests. The budworm is no respecter of boundaries, and the enlightened self-interest of one owner who wants to protect his or her resource against the budworm may be no match for the neglect of a neighboring patch of land owned by out-of-State interests. One CANUSA cooperator, Bob Manthy, has referred to the outcome of such benign neglect as "the cost of doing nothing."

Brent Teillon and the other Vermonters on the tour

repeatedly emphasized that now is the time to be doing something about budworm in the Northeast Kingdom. The sociopolitical climate of the State suggests that B.t. is the treatment of choice.

CANUSA's 1982 B.t. field test was set up to (1) determine performance of five different B.t. treatments and compare spruce budworm larval mortality in treated plots to that in nonsprayed check plots; (2) determine the degree of foliage protection as a result of treatments; and (3) compare results from four other B.t. test locations — Ontario, Minnesota, Maine, and elsewhere in Vermont.

There is no question that B.t. has been tested and proven effective in killing budworms. But field effectiveness has varied in different locales. (So has the effectiveness of chemical insecticides, though we seldom hear about that. . . .) The 1982 test examined results from treatments at 20, 30, and 40 billion international units of B.t. per ha (8, 12, and 16 billion IU/acre). Control plots received no treatment. Spraying was timed to correspond with 90-percent bud burst and near peak fourth-instar development of the insect.

Each plot contained 30 marked codominant balsam fir trees, established on a transect perpendicular to the direction of spraying. Midcrown samples (45-cm branch tips) were clipped from these trees during three sample periods — a prespray sample of larvae on one branch taken within 24 hours of spraying, larval samples of three branches 14 days after spraying, and samples of three branches for evaluation of defoliation of 10 distal buds per branch at 21 days after spraying.

Results of the 1982 test are being analyzed at the Forest Service's Hamden, Connecticut, laboratory. Though the figures haven't been released, those of us on the tour could certainly see evidence of good protection by B.t.

In some parts of Caledonia County, however, it is too late for B.t. Our last stop Thursday afternoon took us to a 16.2-ha (40-acre) clearcut, where local forester Jersey Drown showed us 5437 $m^3$ (1,500 cords) of spruce and fir killed by budworm and stacked waiting for market conditions to improve. Jersey is an old-timer with plenty of budworm experience. Like everyone else we talked to, he wanted "the answer" to the budworm problem in Vermont. Clearcutting is not favored in the area for esthetic reasons, and Jersey would obviously have preferred a smaller cutting strategy. He was advised to leave several "seed trees" to encourage spruce regeneration, because spruce is less likely than fir to be *killed* by budworm. Rick Carmeneti, a consulting forester from Albany, Vermont, suggested another way of handling the budworm problem: cut susceptible stands

*Figure 1. At a pepperoni social, CANUSA-East management, cooperators, local loggers, and Vermont State personnel chat about how to handle spruce budworm with B.t. At the center is E. Bradford "Bugs/Ted" Walker, Vermont State Forester, who is trying to pump Dave Grimble for the elusive silver bullet.*

on a 20-year rotation for pulpwood and forget about growing sawtimber on sites like those we saw in the B.t. plots. This suggestion would probably go over better with Vermonters if they had a pulp mill in their State. Presently, all their pulpwood has to be trucked to New York or New Hampshire/Maine mills.

After trekking over all of Jersey's clearcut, we repaired to the Greensboro trailer on the Withers' property for a group discussion with concerned local loggers and landowners. Also present were a number of the State's natural resources people, including Brendan Whittaker (Secretary of the Agency of Environmental Conservation), E. Bradford Walker (Director of Forests), and Bruce Parker (University of Vermont). These folks also tried to buttonhole CANUSA-East's Applications Coordinator, Dave Grimble, for "the answer." Dave described the Program's technology transfer efforts and was greeted with a favorable audience reaction. Vermonters are ready for a full-scale demonstration in their area showing targeted harvesting and spraying, B.t., and silvicultural management to minimize budworm risk.

Friday, July 30. On our final morning in Vermont, we visited a scleroderris-infected Scots pine stand to hear about this relatively new disease problem from University of Vermont graduate student Steven Zajchowski. Scleroderris is caused by the fungus *Gremmeniella abietina*, which produces tiny spores that travel via rain-splashing. The disease has appeared in New York and Vermont in a particularly virulent form, and no cure exists. University of Vermont researchers have found that pruning all branches from the lower third of the crown of infected red pine results in reduced rates of infection for seedlings, branches, and large trees, compared to infection rates in unpruned plots. It is not even necessary to remove the pruned branches from the site. Steve suggested that leaving them on the forest floor may break up the pattern of rain splashing that is implicated in the spread of scleroderris.

Steve went on to describe his own research in the plot, where he is taking spore counts with special sticky glass plates. Steve has isolated a previously unreported spore form called a "microconidiospore," which may be the life stage of *G. abietina* responsible for scleroderris canker.

Unfortunately, the only alternative for managing land infected with this disease is salvage and regeneration with species other than hard pines. Spruce trees in Steve's plot were untouched by scleroderris even if their branches intertwined with those of infected pines.

Just before our party broke up, Bruce Montgomery, of University of Michigan's School of Natural Resources, showed us a prototype videotape he and his

*Figure 2. Four navigators, (left to right) Carl Palm, Doug Allen, Brent Teillon, and Larry Abrahamson, check directions to Burlington's airport. Their reflections prove that the sun did come out during the tour — for the last 45 minutes.*

*Figure 3. Ted Walker is interviewed for local television as Brendan Whittaker (far right), Secretary of Vermont's Agency of Environmental Conservation, looks on.*

staff had prepared. "Budworming in Michigan" is a 15-minute color videotape designed to show how this medium can be used in reasonably priced technology transfer efforts. Bruce emphasized the merits of videotape: it is much cheaper than 16 mm movies but can readily be transferred to that medium if there is a need to show the tape to a larger audience than can be accommodated by a regular-size TV screen. We anticipate using videotape facilities to make another feature highlighting the outputs of all components of the CANUSA Program.

As the New Yorkers loaded us into their vans for the final leg of the tour, the trip to Burlington's airport, I felt again how beautiful are the northwoods of New England. And how well worth saving.

*Janet Searcy* — Information Coordinator,
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**Utilization Studies Update**

At the recent Forest Products Research Society's International Meeting in New Orleans (June 20-24, 1982), the results of four balsam fir utilization studies were presented to governmental, university, and industrial attendees. The abstracts for each of the four presentations are given here.

"Spruce-Budworm-Killed Balsam Fir as a Raw Material for Waferboard and Flakeboard"
by Mark Hughes and Roland Gertjejansen

This study was initiated to evaluate the use of healthy and spruce-budworm-killed balsam fir as raw materials for flakeboard and waferboard. There are vast quantities, perhaps 40.5 million ha (100 million acres) of stressed and dead balsam fir in eastern Canada and the northern United States resulting from attack by the spruce budworm.

Laboratory waferboard and flakeboard were manufactured from 100-percent healthy balsam fir; 100-percent balsam fir dead 3 months, 1 year, and 2 years; 100-percent healthy aspen; and from 50/50 combinations of aspen with each balsam fir raw material type. For all practical purposes, there were no differences among panels made from 100-percent aspen, healthy balsam fir, balsam fir dead 1 year or less, or the 50/50 combinations of the balsam firs with aspen. Therefore, by inference, any combination of aspen, healthy balsam fir, and balsam fir dead 1 year or less could be used as a furnish for flakeboard or waferboard. The use of 100-percent and 50-percent balsam fir 2 years dead resulted in significant reductions of waferboard internal bond (IB). Therefore, the amount of this material that could be used in combination with aspen for waferboard would be something less than 50 percent, although the exact amount is not known.

"Drying of Balsam Fir"
by Richard A. Hale, James E. Shottafer, and Timothy G. O'Keefe

There is an increase in the percentage of balsam fir in the spruce-fir log mix being sawn in the Northeast because of budworm mortality. Many of the large producers are now separating spruce and fir in the log form to resolve the problems caused by the major difference in drying characteristics of the two species.

The drying of balsam fir is complicated by extreme variability in moisture content, primarily due to the presence of water pockets. The problem in drying this material is essentially that of drying the water pockets to target moisture content without overdrying, which results in excessive degrade due to warpage.

Twenty charges were dried in an experimental dry kiln using both conventional and high-temperature schedules. Intermediate steaming at two places in the schedule appeared to result in improved uniformity of moisture content at target and to reduce the amount of degrade because of drying defects. Two test runs were carried out in a commercial high-temperature kiln. Results indicated improvement in both moisture content characteristics and grade yield.

"Lumber Grade Yields from Healthy and Spruce-Budworm-Killed Balsam Fir"
by Steven A. Sinclair and Robert L. Govett

Historical and more recent spruce budworm outbreaks have damaged and killed vast quantities of balsam fir timber. To better understand the effects of budworm attack on lumber grade yields, balsam fir trees from spruce budworm-infested forests of northern Minnesota were salvaged and processed into dimension lumber at a commercial sawmill. Trees that had been standing dead on the stump for 6, 12, and 22 months were harvested along with healthy and budworm-stressed trees. One year after death, yields of Standard or No. 2 and Better grades had dropped to as low as 9 percent, while yields of Utility, No. 3 and Better or Stud grades remained as high as 68 percent. The primary cause of grade yield loss in dead trees was decay. Healthy balsam fir yielded 58 percent Standard or No. 2 and Better grades with 89 percent in Utility or No. 3 and Better or Stud grades.

"Gross Heat of Combustion of Spruce-Budworm-Damaged Balsam Fir"
by Douglas P. Barnes and Steven A. Sinclair

The spruce budworm has the capability of destroying large quantities of timber in the spruce-fir forests of North America. Timber damaged or killed by these budworm attacks may result in products having lower economic value and increased difficulty of utilization. The use of this damaged balsam fir for fuel is one alternative.

Over 400 balsam fir trees severely weakened by budworm attack in northern Minnesota were identified in early summer 1979. As expected, many of these trees died. Monthly observations, from early spring through late fall, were performed to determine the date of tree death. Five trees having similar breast-height diameters were selected from each of the death categories: control (living), dead 6 months, dead 12 months, and dead 22 months. Disks were removed at 254-cm (100-inch) intervals starting at the base of the tree, and samples from these disks were prepared for gross heat of combustion analysis. Preliminary results indicate that the mean gross heat of combustion for healthy balsam fir is approximately 4800 cal/°C. Trees dead 22 months showed a slight but statistically significant reduction in mean gross heat of combustion. In practice, the small difference in calorific content between healthy balsam fir and balsam dead 22 months would be negligible.

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**Budworm Silvicultural Training Session**

Bill Wulf, silviculturist for CANUSA-West (Timber Management, Missoula), and Donn Cahill, entomologist for CANUSA in Region 4 (Forest Pest Management, Boise), arranged a training session July 14 and 15 at McCall, Idaho, on silvicultural strategies for reducing damage by the western spruce budworm. Attending the meeting were some 25 foresters from the Boise, Payette, and Nezperce National Forests. Bill and Donn discussed the bionomics of the budworm and noted that fire control and selection-cutting practices have created huge forested areas that are particularly vulnerable to the western spruce budworm — forests approaching climax where trees are all-aged, crown canopies are multilayered, and grand firs dominate.

Much of the session was held in the field, where the trainees, armed with data on stand composition and growth, walked through budworm-infested forests. There they discussed the best of silvicultural options available to bring the forests to seral, even-aged conditions with fairly uniform canopies and a limited number of grand firs — the forest conditions least vulnerable to the budworm. The enthusiastic discussion generated by the trainees showed their interest in the information presented; for many, writing silvicultural prescriptions for budworm-susceptible stands is a daily problem.

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**Carbaryl and Crawdads**

The Department of Conservation's Maine Forest Service (MFS) is funding a $15,314 cooperative bioassay study to determine the toxicity of Sevin-4-Oil® to crayfish. Sevin, containing the active ingredient carbaryl, was the principal chemical insecticide sprayed during the 1982 spruce budworm suppression project. Harold L. "Bud" Brown, president of Eco-Analysts, Inc., of Georgetown, Maine, directed the collection of crayfish, which are currently being exposed to varied-strength solutions of carbaryl at a laboratory in New Hampshire. The results will be processed on a special computer program obtained from the Environmental Protection Agency.

Preliminary results show that no crayfish were killed when exposed to carbaryl at one part per million. This concentration is higher than that expected in Maine's carbaryl spray blocks because streams and other bodies of water are protected by unsprayed buffer zones.

The bioassay study is one of seven environmental monitoring and research and human-health monitoring studies being conducted in 1982 at approximate direct costs of $146,000. All studies are funded by spruce budworm project monies. Study results are analyzed and used in developing MFS spray policies and application procedures that reduce overall environmental impact of insecticide control.

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**Alternative Emulsifiers Sought for New Brunswick Spruce Budworm Spray Mixes**

Early in 1982, the Honorable Brenda Robertson, Minister of Health for New Brunswick, established a Task Force to advise her of any possible adverse health effects that might be associated with spruce budworm spraying operations in New Brunswick, especially on the possibility of any connection between budworm spraying and the frequency of Reye's syndrome among children in the province. The Task Force, under the chairmanship of Dr. Walter O. Spitzer, Director of Clinical Epidemiology at the Montreal General Hospital,

McGill University, comprised several well-qualified specialists in various aspects of epidemiology, pediatrics, microbiology, immunology, environmental medicine and biostatistics, from both Canada and the United States. A guiding principle in the Task Force's deliberations was that the greatest possible margin of safety with respect to health effects would be observed, and that even if a procedure in use was judged to be acceptably safe to the Task Force, it would not hesitate to recommend more stringent measures if such measures could clearly be expected to increase the margin of safety to people.

The Task Force made its first report to the New Brunswick Ministry of Health on April 28, 1982, wherein it stated unequivocally that, despite a detailed review of the literature and an epidemiological study it had conducted on its own, the Task Force was unable to determine any relationship between forest spraying in New Brunswick and the incidence of Reye's syndrome among children in the province. Although recognizing that emulsifiers may play a primary role in viral-enhancement, the Task Force further concluded that significant exposure to these agents from forest spraying operations was extremely unlikely, and that if emulsifiers were involved with Reye's syndrome, exposure would most likely occur via other routes.

Despite these overall findings, the Task Force considered it prudent to recommend, among other things, that the emulsifier Atlox 3409® not be used in New Brunswick forest spray mixes beginning in 1982. The Province of New Brunswick reacted to this recommendation by removing Atlox 3409 from its operational spray program against the spruce budworm in 1982, and mounting a substantially reduced program using fenitrothion in Dowanol TPM® and in a mixture of Cyclosol 63® and Insecticide Diluent 585. These constraints were imposed just prior to the 1982 spray program, and it was estimated that their introduction would result in the loss of some 424 750 $m^3$ (1.5 million cunits) of spruce and fir in the province.

Because of these decisions, New Brunswick's forest managers were placed in a very critical position. Understandably, they were anxious to have in place for operational use in 1983 alternative, acceptable, and registered tank-mix options to the questioned and currently registered fenitrothion mixes. To investigate solutions to this problem, a special Subcommittee to the Board of Directors of Forest Protection Limited was formed; and on May 17, 1982, the Subcommittee requested an emergency meeting in Ottawa with appropriate Assistant Deputy Ministers and technical staff from the Canadian Forestry Service, Agriculture Canada, and National Health and Welfare.

At the meeting on May 18 it was agreed that the CFS (through its Forest Pest Management Institute) would take the lead in a coordinated federal-provincial approach aimed at (1) finding acceptable alternative formulations or tank-mixes of both fenitrothion and aminocarb flowable pesticides, and (2) conducting on these formulations the required laboratory and field research and testing to generate the data necessary for their registration in time for operational use by 1983. Agriculture Canada and National Health and Welfare agreed to cooperate in this approach with advice and guidance, and in the registration review process, to give promising formulations or tank mixes high priority. Funding to facilitate the accelerated R & D program involved was to be provided by Forest Protection Limited. All parties at the May 18 meeting stressed that in the search for options, scientific credibility would not be compromised and the registration requirement would not be bypassed. Further, to reach these goals, everyone involved in the coordinated approach would have to give complete cooperation.

On May 19, M.M. Neilson, C.H. Buckner, and G.W. Green of CFS drew up an Action Plan to provide the basis of the coordinated approach. The Action Plan had as its overall objective "to register two additional formulations for aminocarb and fenitrothion, preferably in water emulsions, with the constraints that no viral-enhancing emulsifiers be contained and that no registration requirement be bypassed. To be operational by May, 1983 (Option A) or May, 1984, (Option B)." The Action Plan included a complete range of laboratory and field research and testing, ranging from identification of likely-to-be acceptable emulsifiers and other adjuvants that might be required, through field efficacy and environmental impact testing on both small blocks (50 ha [123.5 acres]) and semioperational blocks (5 000 ha [12,355 acres]), to acute toxicity and viral-enhancement laboratory tests. Two additional committees were organized — a Steering Committee to establish and monitor liaison between federal and provincial departments concerned with the registration process, and to assist in funding those segments of the program over and above that considered the normal responsibilities of the cooperating agencies; and a Facilitation Committee made up representatives from CFS; Agriculture Canada; New Brunswick Departments of Health, Environment, and Natural Resources; the Eastern Spruce Budworm Council; Forest Protection Ltd.; and the Atlantic Region Pesticide Advisory Committee, who through their specific areas of expertise and responsibility were to provide advice and/or assistance to expedite the Action Plan.

The Action Plan (Option A) was approved by the CFS and the Steering and the Facilitation Committees with minor modifications, and subsequently by the pesticide industries involved with both aminocarb and fenitrothion. The full cooperation of all facilitating agencies including those noted as members of the Facilitation Committee, Fisheries and Oceans Canada, the Environmental Protection Service, and the Canadian Wildlife Service of Environment Canada, was obtained during meetings of May 27 and 28 when the program was officially endorsed.

To date, the Action Plan is on track and much has been accomplished. Space available does not permit a detailed accounting of the decisions reached, as the

program developed with exceptionally short lead time, under constraints imposed by limitations in the availability of acceptable test blocks, and the extremely rapid development of budworm larvae in New Brunswick in 1982. Suffice it to say here, that the final selection of tank mixes to be tested in the field included

| | | weight by weight% |
|---|---|---|
| (i) | aminocarb flowable | 24.9 |
| | Triton × 100 | 3.1 |
| | water | 72.0 |
| (ii) | fenitrothion | 14.3 |
| | Cyclosol 63 | 23.7 |
| | Triton × 100 | 3.0 |
| | water | 59.0 |
| (iii) | fenitrothion | 13.9 |
| | Triton × 100 | 13.9 |
| | water | 72.2 |

All of these mixes were applied twice to the small experimental blocks for efficacy testing and for residue studies on various nonaquatic components of the forest environment. They were also to be applied to the large semioperational blocks by TBM aircraft, where both efficacy and environmental impact studies were to be carried out in both terrestrial and aquatic environments. High budworm populations in these large blocks, coupled with extremely rapid larval development, however, resulted in almost total defoliation before the first application; this precluded any meaningful assessment of foliage protection upon which field efficacy is based in the final analysis. Therefore, these blocks were ultimately reduced to about 405 ha (1,000 acres) each. Two applications were made and environmental impact studies were carried out on both the terrestrial and aquatic environments. Impacts on aquatic environments were also enhanced with stream-drip studies, and residues analyses in various components were conducted. At the time of writing, analyses of field data are incomplete; but based on preliminary observations, all mixes appear efficacious with few significant side effects.

Very low temperatures persisted during mixing in the field for the first applications to the small blocks, and problems were encountered in mixing that were not experienced in the laboratory. At such temperatures (7°C and below), Triton × 100 is extremely viscous and difficult to mix with the aqueous compounds of the mixes concerned. This condition could cause problems in operational use, and methods of circumventing them are currently under investigation. While the field work was going on, laboratory studies were underway involving contact and residual toxicity of the mixes to budworm larvae and on the physical properties of the mixes themselves (viscosity, density, evaporation rate, droplet spectrum, and so forth). Again, these studies are not yet complete but initial observations would suggest that all mixes are efficacious and their physical properties may be better than the currently registered mixes.

When the problem of mixing Triton × 100 at low temperatures in the field was encountered, another closely related material, Triton × 114, was investigated in the laboratory. It has a significantly lower pourpoint than Triton × 100 and shows good promise for use, should no easy method of circumventing the mixing problems with Triton × 100 in the field be found. Because of this, mixes with Triton × 114 replacing Triton × 100 have been included in the acute toxicity and viral-enhancement tests that are important elements in the Action Plan.

Presently, an extensive series of acute toxicity tests on the three mixes including Triton × 100 and similar mixes with Triton × 114 replacing Triton × 100, is underway at BioResearch Laboratories in Montreal. These tests include acute oral, acute dermal, dermal sensitization, primary dermal irritation, primary eye irritation, and acute inhalation toxicity studies. Also, arrangements for viral-enhancement studies on all components of the tank mixes, and combinations thereof, at three independent laboratories have been made. These will be blind tests, all done under identical protocols. In addition to the components in the mixes under study, these tests will include other materials known to be viral-enhancing and other materials used in other pesticide formulations.

It is too early yet to predict whether the Action Plan will achieve its primary objective of having acceptable alternative tank mixes for aminocarb flowable and fenitrothion registered and available for operational use in 1983. We are optimistic that this objective will be achieved; but if it is not, an excellent start has been made for achievement by 1984. The extremely close and cooperative approach that this emergency has forced should contribute to a more enlightened consideration of pesticides and pesticide use in forestry by all agencies concerned at all levels than perhaps has been the case in the past.

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**New Brunswick Spray Efficacy Research Group (NBSERG)**

The control of insects by application of insecticides from the air is proving to be a far more complex process than our original, rather naïve, beliefs indicated. In fact, the popular conception of the spray process may well have been the principal culprit, which in the past limited research progress on spray efficacy. Use of the term "spray efficacy" rather than spray technology is central to the new wave of spray-related research in that it reflects the multidisciplinary nature of the process. It helps to point out that the effectiveness of the spray is the end product of a complex chain of scientifically definable events. The interactions among these events must be appreciated before a fully predictive

definition of the overall process can be achieved. (In other words, we have to know what is happening.) However, because these events encompass a variety of scientific disciplines (chemistry, physics, engineering, entomology, meteorology, and so forth), an essential prerequisite to understanding the interaction among the events is interaction among the researchers. Obvious though this may seem, mutual appreciation, let alone understanding between unrelated sciences, is a rare phenomenon. Nevertheless, it is an important element of any truly multidisciplinary R & D effort. Although certain facets of a problem may be addressed in isolation, most will span at least two scientific disciplines. Certainly, as we approach the solution of a problem, when the last pieces of the puzzle of cause and effect are being juggled, a cooperative approach becomes essential.

The spruce budworm problem in New Brunswick is a special case on the North American scene for several historical, economical, operational, and ecological reasons. Since the mid-1970's, New Brunswick has recognized its unique situation and has encouraged research into various aspects of budworm management. Numerous independent studies ranging from basic insect pheromone research to computer modelling of spray dispersion and deposition have been supported through both the New Brunswick Department of Natural Resources and Forest Protection Limited.

Recently, the New Brunswick Task Force on Long-Distance Drift of Forest Insecticides concluded that the lack of interdisciplinary communication and coordination of spray-related research severely hindered progress in that field. The formation of the New Brunswick Spray Efficacy Research Group (NBSERG) represents a united effort to improve upon this situation. NBSERG is, in effect, an association of Canadian individuals and institutions active in research upon various aspects of the spray efficacy process. The Group consists of two bodies. The steering committee, chaired by R. J. Kavanagh, Dean of Graduate Studies and Research at the University of New Brunswick, is composed of management-level representatives of institutions across Canada having mandates or research interests in aerial spraying. The technical committee consists of scientists and operators actively involved in various aspects of spray-related research. NBSERG provides a concrete means for planning cooperative work, minimizing overlap, and evaluating research priorities. Research interests include topics such as the influence of formulation on atomization and droplet characteristics; droplet impaction on various targets; validation and modelling of droplet transport, deposition, vortex effects, and meteorological effects; and influence of host phenology and larval behavior on vulnerability.

A number of interagency cooperative projects have already resulted, for example:

- A 3-year study funded by the Department of Supply and Services (DSS) and the Canadian Forestry Service (CFS) examining the influence of spray parameters, larval behavior, and host phenology on spray efficacy. The cooperators are the Research and Productivity Council, Maritime Forest Research Centre, University of New Brunswick, and Forest Protection Limited.
- A study by Chet Himel (University of Georgia) and Alam Sundaram (Forest Pest Management Institute) of foliar deposition using inflight microencapsulation.
- A study of the influence of meteorological conditions on drift, deposition, and swath width that was funded by Forest Protection Limited and involved the Unsteady Aerodynamics Laboratory of the National Aeronautical Establishment, Atmospheric Environment Service, University of New Brunswick, and the Research and Productivity Council.

To round off 1982, a Spray Efficacy Workshop is being organized in Toronto for November. Spray researchers from Canada, United States, and the United Kingdom will meet to discuss their work and how best to apply their individual areas of expertise to unravelling this complex, multifaceted problem.

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**Budworm-Related Research and Development at RPC**

The Chemistry Department at the Research and Productivity Council (RPC) has been involved during the past 7 years in various aspects of budworm-related R & D. This has included research on the sex pheromone of the budworm as a potential direct or indirect control technique, spray efficacy research (spray drift chemistry and deposit assessment), and pesticide residue analysis (method development, instrumental techniques, and contract service analysis for provincial/federal government agencies and industry). Trace organic chemistry in general, and residue chemistry in particular, have formed a major part of the department's work over the past 7 years. Almost all of this work is performed under contract to provincial and federal government departments and industry on a fee-for-service basis. A variety of instruments and techniques such as computerized gas chromatographs/mass spectrometers (capillary, electron impact/chemical ionization), gas chromatographs with capillary capability and specific detectors, and high-pressure liquid chromatography are in constant use. Insect rearing and holding facilities have been established as well as several electrophysiological and behavioral techniques (e.g., electroantennogram and sustained-flight wind tunnel, respectively).

With an initial grant from the Department of Regional Economic Expansion (DREE), and later support from the New Brunswick Department of Natural Resources, the assessment of the potential of using sex pheromones as a control technique for spruce budworm has been ongoing since 1977. The work began with a reinvestigation of the sex pheromone of the insect and culminated recently in both the chemical and behavioral identification of several minor components, which are presently under investigation in the laboratory and the field.

The use of the primary components of the pheromone as mating disruptants has been intensely researched during this period (CFS, UNB, RPC and USDA Forest Service/University of Maine, Orono). Some progress has been made in this direction, but identifiable gaps in our present knowledge have surfaced. RPC was involved in three major mating disruptions trials: San Quentin, CFS (NB) 1978; Machias, USDA Forest Service/University of Maine (Maine) 1979; and Sault Ste. Marie, CFS (Ontario) 1981. RPC's principal role in these trials was to develop methods for, and to monitor, controlled-release formulation (CRF) performance after aerial application during the trials. Under a separate contract, RPC has assessed the performance of the majority of commercially available CRF's, and these techniques were used to determine the release characteristics of several CRF's as spruce budworm trap-baits (CANUSA-and CFS-funded). In 1979, RPC began investigating the potential of a male annihilation strategy. This involved using the pheromone to induce lure contact where males would encounter a contact insecticide. This work, initially funded by Forest Protection Limited and later CANUSA-East, is still under investigation and shows some promise.

This year, we have looked at the effect of releaser distribution and release rate on mating disruption in order to optimize these parameters. Positive results have emerged and will be published soon. The search for missing components of the pheromone, particularly those involved in releasing short range behavior, continued this year with the discovery of, as yet, unnamed additional components. This aspect of the research must be clarified before any further large-scale mating disruption trials.

In addition to the spruce budworm, the sex pheromones of the following insects are under investigation: jack pine budworm (*Choristoneura pinus*), western spruce budworm (*C. occidentalis*), eastern hemlock looper (*Lambdina fiscellaria fiscellaria*), and oak leaf shredder (*Croesia semipurpurana*). Much of this work is complete and will be published soon. Additional semiochemical research is being carried out under contract in the following areas: identification of host-related chemicals attractive to the native elm bark beetle (*Hylurgopinus rufipes*, CFS), identification of the oviposition-deterring pheromone of the blueberry maggot (*Rhagoletis mendax*, Ag. Canada), and identification of a bovine estrus pheromone (Ag. Canada).

Involvement in budworm spray efficacy research has intensified this year with work being conducted on droplet deposition assessment, rapid field methods for fenitrothion total deposit assessment, and atmospheric chemistry of droplets and vapor in near-field drift situations.

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**Efficacy of an Economical, Concentrated *Bacillus thuringiensis* (B.t.) Formulation for the Control of *Choristoneura fumiferana***

A highly concentrated B.t. formulation called Futura has been under development for 4 years by the Insect Pathology Unit of the Laurentian Forest Research Centre (LFRC) at Quebec City. This formulation permits the required dosage of B.t. (20 billion IU/ha) to be applied against *C. fumiferana* in aerial spray operations at the low dispersal rate of 2.5 L/ha (0.22 imp. gal./acre). Experimental aerial treatments with this B.t. formulation during the last 3 years with an Agcat aircraft, and another treatment last year by the Quebec Department of Energy and Resources (QDER) with a Super Constellation aircraft, gave promising results.

This year, aerial spray operations with Futura, at the same dosage and dispersal rate, have been carried out in cooperation with the QDER, using a DC-4 equipped with a boom and open nozzles, over 4 000 ha (9,884 acres) of forest highly infested by *C. fumiferana* larvae (32 larvae/45-cm branch tip). The results have been most satisfactory in terms of decreased *C. fumiferana* populations and foliage protection obtained. Larval mortality was 90 percent and final defoliation was 35 percent. In addition, the application of Futura by an Agcat aircraft to highly infested plots (30 to 35 larvae/45 cm) has also been successful: larval mortality was 95 percent and final mean defoliation, 15 percent.

The 1982 results have shown that the formulation is efficient at various temperatures and does not freeze, and that the anti-evaporant, sorbitol, is essential to low volume B.t. applications. Futura can be used efficiently and economically for the operational control of *C. fumiferana*.

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**Spray Technology Studies Listed by the CANUSA Basic Record, 1982**

CANUSA Basic Record No. 7, April 1982, is the reference for this listing of current spray technology studies relevant to insecticide efficacy for budworm and to off-target drift. The Basic Record was set up by CANUSA to update annual progress reports, starting in 1978, but in practice, many contributors have not supplied reports for 1981 and/or 1980 so that it is difficult to determine current inputs or continuing researcher

interest. Therefore, this summary of Basic Record (BR) No. 7 uses the past tense to describe studies (record number in parentheses) except where it is known that investigations are continuing and the present tense is applicable.

Research activities are grouped under headings which conform to the steps of the spray process itself: spray emission kinetics, atmospheric transport over the swath, deposit of droplets, budworm response to deposit; and to operational needs for information on spray technique and the drift phenomenon. This summary does not include studies on B.T.

### Emission Kinetics

The quality of the emission depends upon aircraft capability, nozzle design, and formulation characteristics; all are interactive. BR lists studies on nozzle development: by Wedding (176) using wind tunnels; by Yates and Akesson (235) seeking narrow spectrum atomization (by choice within 100-400 $\mu$m); and by Ekblad (367, 371) devising a narrow-spectrum hardware for droplets <100 $\mu$m. Yates (387) analyzed the size-frequency of droplets just released from a boom nozzle with a laser device mounted on the aircraft.

Himel (220) worked on polymer encapsulation of insecticide formulations, and Sundaram (unlisted) is making a comparative study of the influence of carriers and emulsifiers (for conventional insecticides) on emission kinetics.

### Atmospheric Transport

This is the transport of droplets beyond the area of spray flow shear. Picot (295) is seeking to use a laser probe in a wind tunnel to determine droplet size-frequency for conventional hardware and formulations. Harris (133) was studying particle losses from inflight droplets relative to meteorological conditions and to formulations. Picot (286) and Crabbe (289) are continuing their studies to model near-field droplet transport processes. Ekblad (370) proposed studies in wake/canopy interaction, comparing rotary and fixed-wing aircraft.

### Deposits

Much of the work on kinetics and transport is aimed at producing droplets of optimum size for coverage of conifer foliage at cost-effective rates. There is general interest in determining that optimal size. Potts (223) conducted wind-tunnel studies to measure drag coefficients of spruce foliage (bearing on the deposition pattern relative to wind direction). Picot (unlisted) has tested foliage simulators, and Wiesner (unlisted) has conducted droplet counts on foliage, to determine optimum droplet sizes for deposit across the swath. Ekblad (368) has developed sensitized cards and electronic scanning for deposit assessment on cylindrical samplers. The Pendrel study (298) using Kromekote cards has been discontinued.

### Budworm Response

Richmond (150) is using fixed towers and small trees to simulate the influence of aerial spray on budworm mortality. Force (382) proposed in 1981 to develop a probability model to predict larval mortality based on deposit and toxicological factors. Cadogan (307) is conducting efficacy evaluations of new candidate formulations of aminocarb for the registration process.

Varty (377) is attempting to define the target for droplet deposition and the conditions under which larvae are vulnerable. Nigam (unlisted) is studying potential toxicological mechanisms leading to budworm mortality in the field.

### Operational Factors

Spray timing (larval phenology) was studied by Auger (1) for fenitrothion and Blais (75) for aminocarb. They indicated that earlier spray regimes (L2, L3) were less efficaceous than later regimes (L4, L5). Varty (377) investigated the differences between earlier spray (L3) and later spray (L4) for phenologically distinct populations on fir and red spruce. Kettela (23) has shown that one application of fenitrothion (280 g/ha) was less effective than two applications (210 g/ha).

Jasumback (129) and Akesson and Yates (148) investigated aircraft guidance systems. Ashley (90) investigated ways to better delineate nontarget areas within a proposed spray block.

### Drift

Spray operators recognize that off-target drift is a source of public distrust and regulatory restriction, as well as minor waste of insecticide. The main effort to account for drift is grouped around the New Brunswick Task Force on Long-distance Drift of Forest Insecticides (Varty 285). Under this umbrella, Picot (286) and Crabbe (289) are modelling drift transport and deposition as a function of aircraft parameters, weather factors, forest canopy surfaces, and distance downwind, using field tests and wind-tunnel experimentation. Silk (288) and Addison (287) have studied inflight chemistry of fenitrothion and aminocarb to determine degradation rate and vaporization characteristics. Elias (unlisted) has developed gas chromatograph sampling capability for drift aerosols. Ekblad (368) was developing a method of drift measurement by use of paper samplers for aerosols. Mallet (unlisted) has surveyed drift contamination of air, water, and foliage, and Pearce (60) has measured contamination of rain up to 45 km (28 miles) downwind.

Wood (18,280) developed air sampling for insecticides applicable to the risk of poisoning pollinators in blueberry fields downwind of spray blocks. Varty (377) measured sensitivity of budworm populations to drift up to 1200 m (3,937 ft) downwind.

### CANUSA Working Group on Population Treatments

*Newsletter* No. 21 )March 1982) summarized the Quebec meeting (Oct. 1981) of the scientists concerned with aerial application techniques. The meeting emphasized the need for further research on budworm behavior and vulnerability of pesticides, the special needs of B.t. spray technology, and the limitations of current deposit assessment techniques.

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**Meetings**

The 1983 Spruce Budworm Research Work Conference will be held in Orono, Maine, January 10-11, on the University of Maine campus. Tom Rumpf, of the Maine Forest Service, describes the meeting as "a forum for researchers, land managers, and concerned members of the public to review and discuss the latest developments in budworm research with particular reference to Maine." For more information or a copy of the agenda, call Tom at (207) 289-2791.

**JPU and JPPC Meet Together in the Soo**

George Green, director of the Forest Pest Management Institute, and Jim Cayford, director of the Great Lakes Forest Research Centre, welcomed members of CANUSA's two governing committees to Canadian Forestry Service headquarters in Sault Ste. Marie, Ontario. The committees — the Joint Planning Unit (JPU) and Joint Policy and Program Council (JPPC) — met August 16-17 and 18-19, respectively, with JPU members invited to stay on for the JPPC meeting. This sequence of events was a first for 1982; in previous years the JPU met in July and passed along its recommendations to the JPPC at its August meeting.

**JPU**

Gerald Anderson and Murray Neilson cochaired the meeting; also attending were Jim Stewart, Fred Knight (for Jay Hughes), Tom Sterner, and Gerard Paquet. The Program was represented by Mel McKnight, Chuck Buckner, Bob Taylor, and Janet Searcy.

The Joint Planning Unit examined the 1983 Plan of Work as submitted by Program Management and recommended that the JPPC require revision to ensure that CANUSA research results be documented by the end of the Program. At the time, the question of extending accelerated funding beyond September 30, 1983, had not been resolved. However, when the 1-year extension was announced at the JPPC meeting, the JPU's recommendation was modified to require complete documentation by September 1983 but to extend the completion date for Program-sponsored activities to September 1984.

*Figure 4. The Joint Planning Unit, Joint Policy and Program Council, and guests, in front of the GLFRC. Seated: Gerald Anderson, Murray Neilson, Chuck Buckner, Mel McKnight. Row 2: Bob Taylor, John Ohman, Gerard Paquet, Janet Searcy, Tom Sterner, Fred Knight, Jean-Guy Davidson, and Denver Burns. Row 3: George Green, Bob Buckman, Jim Cayford, Hal Stanley, Jim Stewart, Jack Sullivan, and Pete Orr.*

The JPU next considered a point brought up in 1981 — the development of remote sensing capability within the Canadian component. Though the Canadian Forestry Service has agreed to fund a scientist position in this field at the Petawawa National Forestry Institute, the position has not been filled. The JPU recommended that the JPPC express its concern over the lack of progress in the CFS program on remote sensing as a tool in detection of budworm and damage appraisal.

The subject of the CANUSA Program critique is another repeat from 1981. Last year Ken Stratton, Jay Hughes, and Tom Sterner were asked to study possible formats for a critique. Working from this team's material, Anderson and Neilson prepared an executive summary of an action plan for the critique, and this document was discussed in its entirety by the JPU.

The three objectives of the critique were: A. Evaluate achievement of the objectives and terms of the Memorandum of Understanding between Canada and the United States; B. Evaluate the effectiveness of Program organization and administration; and C. Evaluate the effectiveness of the elements (Canada, U.S.A.) of the CANUSA Program in meeting users' needs.

The JPU decided that action on item B would be appropriate for the coming year, especially since answers derived from it could help shape future R&D programs.

Objectives A and C should be investigated later, the JPU determined, after final outputs (publications) are available for users to evaluate. No action item arose from the discussion of the CANUSA critique, however.

Some time at every JPU meeting is devoted to checking back on action items from previous meetings. On the subject of *working group meetings*, the Program Leaders stated that the western component plans no meeting during 1982. The eastern component will meet in April 1983 at St. Paul for a discussion of "what we have and how we should get it out to users."

The 1982 *Program management meeting* has been moved up from December to October so that managers can discuss the critique. This meeting, to take place on Cape Breton Island, will be covered in the January *Newsletter*.

Chuck Buckner reported on the two *modelling meetings* held since last year's JPU assembly. Modellers at the meetings concluded that they have sufficient knowledge of one another's programs so that immediate follow-up was not needed.

On the subject of *transition planning*, the JPU recommended that the JPPC take steps to ensure that the spirit of continued cooperation and coordination of efforts developed during CANUSA continue after the Program ends. This sentiment took form as a new action item charging the Program Leaders to propose a framework for continuation of U.S./Canada cooperative budworms research, development, and related activities beyond the life of the current agreement.

The Program's plan for *scientific, technical, and popular documentation* was outlined for the JPU by Janet Searcy. The eastern U.S. component is on schedule with their publications and expects to complete their documentation efforts by September 30, 1983. The western U.S. component submitted a publication schedule that would run through FY 1985, but this schedule did not find favor with the JPU.

Janet passed out a list of 33 proposed USDA series publications and brought the JPU up to date on the status of the ongoing bibliography project. Other publication plans include the Program Accomplishments Report and a followup to the recent brochure "Are Pesticides A Risk?" that will be written with Fred Honing of Forest Pest Management in the Washington Office.

The JPU also considered making a Program-wide audiovisual device (videotape, slide-tape) as a way to achieve "popular documentation" for the general public. CANUSA cooperators from the University of Michigan provided a prototype videotape called "Budworming in Michigan" to demonstrate what that medium could do for us. Unfortunately, the meeting schedule kept us from showing the videotape to the JPU. The JPPC continued to discuss this topic, however, and instructed the Program Leaders to proceed with developing an information device for the public at large.

In wrapping up this year's JPU meeting with a self-critique, the members expressed that they felt a renewed sense of purpose and cohesiveness. There was general agreement that the committee had matured into a body capable of influencing the JPPC, and the overall Program, in ways that had been envisioned when the JPU was first convened.

Next year's JPU meeting will take place in the Pacific Northwest (U.S. side) in the summer, but the question of whether to meet again with the JPPC was not resolved.

Cochairmen Neilson and Anderson thanked our hosts at the Soo for their fine hospitality, and the JPU repaired to a joint dinner with the JPPC, which served to kick off their meeting.

**JPPC**

The cochairmen of the Joint Policy and Program Council, Bob Buckman and Jim Cayford, welcomed Jack Sullivan, John Ohman, Fred Knight, George Green, and Hal Stanley to the annual meeting August 18. JPU members also sat in, along with Program Management and guests Denver Burns, Pete Orr, and Jean-Guy Davidson.

Chuck Buckner updated the JPPC on the status of Canadian Program components and their plans for 1983. The Program is nearly on schedule, and most of the outputs promised in the Activity Schedule will be delivered within the life of CANUSA.

Chuck pointed with pride to several significant joint research ventures:

(1) pheromone trapping programs to detect low-level populations and incipient outbreaks,
(2) stand prognosis modelling,

(3) integrated product quality research,
(4) B.t. development for operational use,
(5) integrated strategy modelling,
(6) information flow and technology transfer efforts.

He also expressed concern about the rate of progress in some activities:

(1) cartographic history of outbreaks,
(2) remote sensing as a tool for detection and appraisal,
(3) apparent lack of coordination of outputs in the technology transfer areas of some of the western U.S./western Canada programs.

Speaking on the status of the U.S. components, Mel McKnight pointed out the several proposed changes in the Activity Schedule as laid down in the capstone document Plan of Work for 1983. Most changes dealt with minor alterations in format of the output statements, additions to outputs not previously stated, or changes in output statement philosophy following knowledge of research results. One proposed change — in target 6, where the western U.S. component delayed documentation from 1983 to 1985 to permit further gathering of research data — elicited further discussion by the JPPC members.

Three action items arose from discussion of the Program's plan of work and budget for 1983.

1. The cochairmen of the JPPC will write the Assistant Deputy Minister, Canadian Forestry Service, urging the early appointment of a scientist, with necessary funding, to lead the program of remote sensing as a tool in the detection and damage appraisal of budworm-infested stands.
2. If outside forces engender changes in resource allocations that would likely have an impact on projected CANUSA outputs, the JPU will recommend to the JPPC courses of action with respect to program adjustments within 30 days of receipt of information from CANUSA Program Management.
3. The JPPC instructs the Program Leaders to prepare a revised plan of work, budget, activity schedule, and transition plan that will ensure completion of documentation of the components of the CANUSA Program by September 1983, and completion of Program-sponsored activities by September 1984.

Status of CANUSA beyond 1983 was a major topic for both JPU and JPPC meetings. Extending the Program is mainly a concern on the U.S. side because the U.S. element is funded with accelerated research, development, and application monies to supplement the limited spruce budworms research in the regular Forest Service budget. It is understood that budworm research in Canada will continue unabated after CANUSA expires, but in the United States it will return to base-funded levels.

For much of 1982 CANUSA Program Management prepared background data to support a request for a 2-year extension of accelerated funding. The extra years were needed to complete our information and technology transfer plans.

Cochairman Buckman reported that the matter had been seriously considered at the top of the agency, especially in relation to budget projections beyond FY 1983 and other high-priority pest problems urgently needing attention. Although the desirability of a longer extension was recognized, the decision was made to grant a 1-year extension for the specific purpose of information and technology transfer activities to promote the application of Program results. The JPU and JPPC members acknowledged that many research questions will be unresolved during the life of CANUSA. These will continue to be addressed, however, in base-funded research on both sides of the border. After discussing the 1-year extension, both committees agreed the action was appropriate.

In the area of Program critique, the JPPC accepted the JPU's proposal that an evaluation of the effectiveness of Program organization and administration (objective B) should proceed immediately. Objectives A and C (see earlier) should not be addressed until the final phase of the joint program, in 1984.

To achieve objective B, the JPPC felt a single, small team with representation from both U.S. and Canadian elements, should do the job for the JPU. For credibility's sake, the evaluation team will not include members of the CANUSA Program's administration, but appropriate expertise may be available within the participating agencies and departments.

The action item on this matter directs the JPU to proceed immediately with objective B. Further action on A and C will be considered at the 1983 JPPC meeting.

Next on the agenda was discussion of action items from previous meetings, a section similar to that reported earlier under the JPU heading. The JPPC spent some time on the *Newsletter*, which they consider to be the most powerful linking mechanism of the joint program. During 1982 the U.S. side arranged to have the *Newsletter* mailed to appropriate members of Congress and congressional committees. The JPPC recommended that Canada follow suit and expand the mailing list to include the Canadian Parliamentary Committee on Forestry.

The JPPC took note that the *Newsletter's* "Items from the Press" column has been featuring only Canadian articles. The U.S. side does not employ a clipping service, so American articles have not showed up at the Information Coordinator's desk, where U.S. contributions are collected. The JPPC directed the Information Coordinator to develop sources for press clippings about budworm-related activities, either from Forest Service experiment stations and regional/area offices, or from paid clipping services.

Other "old business" topics included publication plans and the international research symposium. The symposium is tentatively scheduled for September 1984 in Bangor, Maine, or Boston, Massachusetts. Jack Sullivan pointed out that the symposium presents an opportunity to accomplish objective A of the Program critique.

The JPPC concurred with the JPU that CANUSA should develop a device in videotape, film, or slide-tape format to reach our nontechnical audience with the good word about our accomplishments. The vehicle should reflect the work of all components (Canada, eastern U.S., and western U.S.); focus on Program results; invite further inquiry from the audience; be produced in an easy-to-use, portable format; and target itself to the informed layman. The project will be a joint U.S.-Canadian output, jointly financed. No budget was specified. The discussion led to an action item directing the Program Leaders to proceed with developing an information device on the CANUSA Program.

George Green reported to the JPPC on the Canadian Forestry Service's action plan for requesting new formulations of insecticides for budworm control operations. Mounting public pressure led New Brunswick's Minister of Health to commission a task force to examine the possible role of aerial spraying in various human ailments, especially the neurological disorder Reye's syndrome. The task force report, released in April of 1982, indicated that no linkage could be demonstrated between the spray program and human health conditions. But the report recommended that the emulsifier Atlox be immediately removed from all spray formulations.

The Canadian Forestry Service was picked to launch a comprehensive project to find four alternative formulations of the two registered insecticides. The new formulas were to contain no viral-enhancing products and to be registered by May 1983. Research began at once and was conducted primarily in George Green's shop at FPMI. George reported that progress to date was satisfactory, and he expects to have the needed formulations registered for use against budworm in Canada by the target date of the 1983 spray season. Although the crash program obviously required redirection of some of FPMI's budget, George indicated that he was able to sustain most of FPMI's CANUSA commitments.

At the close of the meeting, JPPC members indicated that they felt a full 2-day session was needed to deliberate on recommendations from the JPU and other discussion items. Holding the assembly jointly with the JPU was considered highly successful. To help next year's attendees, the JPPC formed a final action item directing Mel and Chuck to prepare executive summaries for principal agenda items for the 1983 meeting.

Cochairman Buckman invited both committees to meet in Corvallis, Oregon, preceding the Society of American Foresters' meeting in September. Next year's joint sessions will be structured around the theme of information and technology transfer.

**Education Spinoffs**

In 1981, Program Management took a nationwide inventory of cooperators on the American side of the border, asking each to list their students funded with CANUSA money. While we hasten to note that producing ever more Ph.D.'s is *not* a Program target, we do point with pride to the fact that CANUSA has helped degree candidates while benefiting from their youthful outlook and enthusiasm.

As of last fall, CANUSA-U.S. had supported, wholly or in part, the work of 32 doctoral candidates, 56 master's degree candidates, 316 undergraduates (nearly all part-time workers for one or two semesters), and 16 researchers in the "other" category — mostly postdocs.

**Budworm Spray Project Underway**

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As often happens with a major pest control project, weather and other factors create a touch-and-go atmosphere.

According to project director Randy Perkins, the situation involving the western spruce budworm spray project is no different. Perkins is pesticide use coordinator, State and Private Forestry, Forest Pest Management, in the Regional Office.

Aerial spraying of 53 824 ha (133,000 acres) in eastern Oregon for an infestation of the budworm began June 20, after a 5-day delay caused by cooler temperatures which slowed the insect's development. Initial estimates called for spraying to begin June 15, then June 17, before June 20 was set. In addition to the weather, start of the project was in doubt because of two appeals. Late last week (the week of June 15), however, the appeals were denied in the Chief's office.

The project, in an area near the communities of John Day, Heppner, and Ukiah, was trimmed to 53 824 ha (133,000 acres) from 84 176 ha (208,000 acres) because of a lack of funds to do the entire project.

Despite the smaller area being treated, Perkins says, the project is expected to be effective in controlling the budworm. About 50 182 ha (124,000 acres) will be treated with Sevin 4-Oil®, a chemical used for insect control on pests, in yards and gardens, and for mosquito control.

Registered and approved by the Environmental Protection Agency, Sevin 4-Oil was used in effective control efforts against the budworm in eastern Washington in 1977 and in eastern Oregon in 1979.

Nearly 3 642 ha (9,000 acres) will be treated with the chemical Orthene®. This acreage is in a watershed where the two forest management agencies feel extra precautions must be taken to protect aquatic insects vital to the diet of young Chinook salmon.

Low concentrations of budworm populations are always present in Douglas-fir, true fir, western larch, and Engelmann spruce species. Insect populations in

eastern Oregon have reached such proportions that control measures must be taken to avoid unacceptable tree growth loss and tree mortality.

The spray project is being conducted by the Oregon Department of Forestry and the Forest Service on 6 880 ha (17,000 acres) of private land and 46 945 ha (116,000 acres) of Malheur and Umatilla National Forest land. Project headquarters are in John Day, with a satellite entomological office located in Ukiah.

All costs incurred to treat Federal lands will be paid by the Federal Government. The State of Oregon and U.S. Government each will pay 12.5 percent of the cost on private lands, and private landowners will pay the remaining 75 percent of the treatment costs.

**1982 Defoliation Estimates — U.S.**

Tom Hofacker, of Forest Pest Management, USDA Forest Service, provided defoliation estimates for 1982 in tables that compared this year's figures with actual areas of defoliation for 1980 and 1981. Spruce budworm damage reached new highs in Maine and Minnesota this year and returned to higher levels in New Hampshire and Vermont after slacking off in 1981. Michigan enjoyed a reduction in budworm activity, and Wisconsin's defoliation estimate represents a complete population collapse.

Western spruce budworm activity in 1982 followed a similar path. Forest Service Region 1 (Montana, northern Idaho, North Dakota, and northern South Dakota) and Region 6 (Oregon and Washington) experienced the sharpest rise — three- and five-fold increases, respectively, in areas defoliated over last year. Defoliation decreased marginally in Region 2 (Colorado, eastern Wyoming, and the Plains States) and by about a third in Region 3 (Arizona and New Mexico). Region 4 (southern Idaho, Nevada, Utah, western Wyoming) posted a 40-percent increase in 1982.

All figures represent aerial detection of budworm defoliation based on survey flights by State cooperators and personnel from State and Private Forestry.

FPM also listed the following areas as treated for budworm in 1982:

| | | |
|---|---|---|
| Maine | 906,700 acres | (366 936 ha) |
| Region 3 | 68,313 acres | ( 27 646 ha) |
| Region 6 | 178,549 acres | ( 72 258 ha) |
| Total | 1,153,562 acres | (466 840 ha) |

New Hampshire originally asked for Federal cost-sharing funds to spray but elected not to treat for budworm.

**Translation Service Comes to Maine**

Ms. Ethelle Lord is the founder and director of a new translation bureau in Maine. With more than 14 years experience in translation, Ms. Lord has the experience and expertise necessary for a translator. She was educated in Canada and worked closely with the Translation Bureau in Fredericton, New Brunswick, from 1967 to 1974. She provides both written and oral translation service in French and English. Her address is 18 Brookside Avenue, Augusta, ME 04330; phone (207) 622-2814.

Table 1. Three-year trend in area defoliated by spruce budworm in the Northeastern United States

| State | 1980 | | 1981 | | Estimate for 1982 | |
|---|---|---|---|---|---|---|
| | Acres | Hectares | Acres | Hectares | Acres | Hectares |
| Maine | 5,000,000 | 2 023 500 | 4,000,000 | 1 618 800 | 5,250,000 | 2 124 675 |
| Michigan | 859,000 | 347 637 | 161,000 | 65 157 | 144,000 | 58 277 |
| Minnesota | 103,000 | 41 684 | 110,000 | 44 517 | 126,731 | 51 288 |
| New Hampshire | 90,000 | 36 423 | 42,000 | 16 997 | 50,000 | 20 235 |
| Vermont | 111,000 | 44 922 | 94,000 | 38 042 | 100,000 | 40 470 |
| Wisconsin | 439,000 | 177 663 | 84,000 | 33 995 | 2,000 | 809 |
| Total | 6,602,000 | 2 671 829 | 4,491,000 | 1 817 508 | 5,672,731 | 2 295 754 |

Table 2. Three-year trend in areas defoliated by western spruce budworm in the Western United States

| USDA Forest Service Region | 1980 | | 1981 | | Estimate for 1982 | |
|---|---|---|---|---|---|---|
| | Acres | Hectares | Acres | Hectares | Acres | Hectares |
| 1 | 976,072 | 395 016 | 931,953 | 377 161 | ± 3,000,000 | ± 1 214 100 |
| 2 | 1,052,000 | 425 744 | 1,768,000 | 715 509 | 1,400,000 | 566 580 |
| 3 | 299,000 | 121 005 | 477,960 | 193 430 | 320,000 | 129 504 |
| 4 | 1,522,000 | 615 953 | 1,411,200 | 571 113 | 2,000,000 | 809 400 |
| 6 | 229,400 | 92 838 | 342,690 | 138 687 | 1,600,000 | 647 520 |
| Total | 4,078,472 | 1 650 556 | 4,931,803 | 1 995 900 | 8,320,000 | 3 367 104 |

**JPPC Meeting Attracts Media Interest**

Frequently, government officials are accused of operating in secrecy without justification for doing so. Such was not the case, however, at this year's combined meeting of CANUSA's Joint Planning Unit (JPU) and the Joint Policy and Program Council (JPPC) held at the Forest Pest Management Institute, Sault Ste. Marie, Ontario, the week of August 16. Conscious of public concern about the spruce budworm problem because of its effect on communities that depend on our forests for their livelihood, members of the JPPC provided a comprehensive program to convey to the public the proceedings and conclusions reached at the meeting.

The media were invited to a press conference prior to the meeting and were given the opportunity to interview delegates and accompany them on a field trip. The media were also invited to attend the sessions, which focused on the CANUSA Program assignments being undertaken by the Forest Pest Management Institute and the Great Lakes Forest Research Centre. The conference received extensive and favorable coverage by the local press who responded to the invitation by the JPPC to attend the event.

**New Regional Director of the CFS in Quebec**

On August 2, 1982, Gilbert Paillé became the new Regional Director of the Canadian Forestry Service at the Laurentian Forest Research Centre, Quebec City.

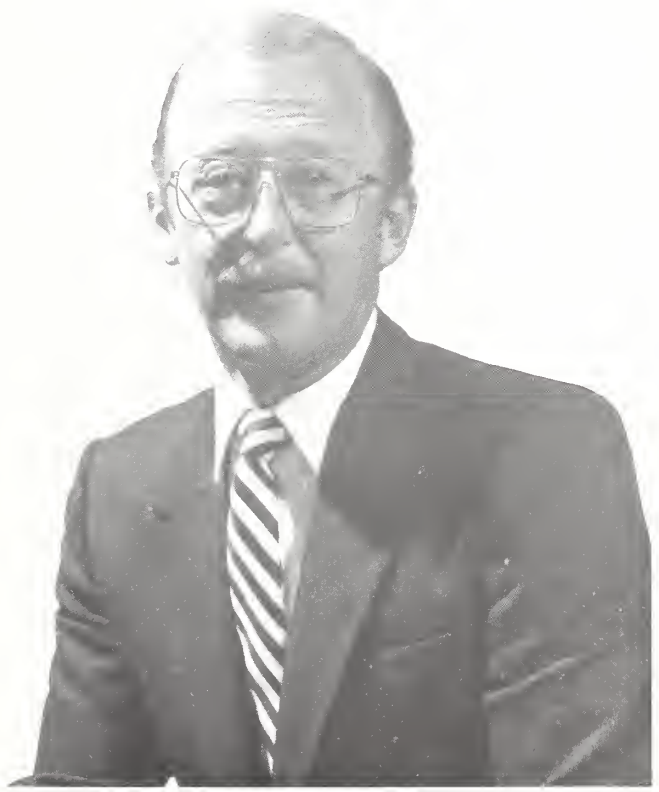

*Figure 5. Gilbert Paillé, newly appointed as Regional Director, Canadian Forestry Service, Laurentian Forest Research Centre at Quebec City.*

Formerly Director of Forest Research at Canada International Paper (CIP), he holds a B.Sc. in forestry from Laval University, Quebec City, a Master's degree from Laval, and a Ph.D. in forest management from the University of British Columbia.

Gilbert is no stranger to the CANUSA Program, having helped set up various research activities from 1978 to 1981 with CANUSA-East concerning the effects of forest treatments on the behavior of the spruce budworm. His extensive experience of forest management and research will be of great benefit to the LFRC and CFS.

**Are You Receiving your Newsletters on Schedule?**

On September 27, 1982, an interesting article on the efficiency of Canada Post in the Ottawa area appeared in the daily newspaper, the *Ottawa Citizen*. According to the author, Ottawa residents enjoy the questionable distinction of receiving the worst postal service in Canada. This lamentable situation directly affects the efforts of those of us concerned with trying to get your *Newsletter* to you within a reasonable time. As you are no doubt aware, the final editing, assembling, printing, and ultimate mailing of this publication takes place here in Canada. Once the printing contractors have provided us with a finished product, delivery is made to Environment Canada Distribution Centre, where the copies are placed in envelopes, address labeled, postage metered, and mailed. Those destined for the United States have an additional hurdle to clear — they are sent in bulk to Toronto, where they obtain postal and customs clearance. This system can work well if all the actors in the play fulfill their various roles. Occasionally, however, there are delays. One such delay is obviously associated with Ottawa's postal lethargy. Another is the work load and priorities of the Distribution Centre personnel. And yet another is the part that postal inspection and customs play. If all these facets happen to be in low gear simultaneously, considerable delays in your receipt of the *Newsletter* can result. Such was probably the case with respect to issue Number 23. Some of you may have experienced a 7-to-8-week delay before you received the July issue, which reached the Distribution Centre on August 2.

I know you are all anxiously awaiting your copy of the *Newsletter* every second month. If you believe that your copy has been lost or delayed, a letter to me, your coeditor, would be appreciated so that steps can be taken to rush you your copy. Address your request to:

C.H. Buckner, Coeditor
CANUSA Newsletter
Canadian Forestry Service
19th Floor, Place Vincent Massey
Ottawa, Ont.
K1A 1G5

We would also appreciate receiving comments from all recipients of the *Newsletter* indicating your satisfaction, or lack thereof, of the timeliness and content of the *Newsletter*.

**Items from the Press**

Epidemic Hits State Timberland. — A state official says an epidemic of spruce budworm has infested 1.4 million acres of Colorado timberland and could spread to another 800,000 acres this summer.

State and federal forestry officials said, however, that few organized suppression programs are planned in Colorado or Wyoming. The epidemic could last another eight to 10 years and kill up to 30 percent of the mature Douglas firs in the Rockies.

"In both the size of the affected area and the duration (since 1977), this outbreak appears to be the most extensive since we began keeping records in the 1930s," said U.S. Forest Service entomologist R. D. Averill. "Visible defoliation of trees will be apparent in the next two weeks."

The spruce budworm attacks Douglas and other kinds of fir and spruce, killing by defoliating the tree over a period of about four years. The better-known pine beetle can kill a tree in one season.

Ralph Read, retired forester and chairman of the Estes Valley Improvement Association, said forest kill is showing up in the Estes Park region.

"We were told by the state and federal forest people that money was not available to participate in a spraying program," he said. The U.S. Forest Service "said if landowners wanted to spray on the borders adjoining our property we could, but most of the private land in this area is interspersed with national forests, including Rocky Mountain National Park."

Aerial spraying costs average $8 to $12 an acre and is about 90 percent effective.

Earlier this year, the U.S. Forest Service recommended against spraying and opted to let the natural course of events run. An experimental eradication program on 12,000 acres of national forest in New Mexico has been 85 to 90 percent effective.

(Rocky Mountain News — July 9, 1982)
Denver, Colorado,

Canada, U.S. Sign Forestry Agreement. — Canada and the United States have signed a forestry management agreement to increase international cooperation on a range of projects from fighting forest fires to slowing the spread of spruce budworm.

Environment Minister John Roberts signed for Canada and Agriculture Secretary John Block for the U.S. They agreed at a brief ceremony that the memorandum of understanding would speed and simplify international management of forestry relations.

In addition to fires and insects, the agreement covers cooperation in areas including monitoring water and air quality and keeping an inventory of forest resources in both countries.

Roberts said he anticipates supplementary agreements will soon be worked out to set shared standards for sizing products of the lumber industry in both countries.

(The Province — June 27, 1982)
Vancouver, British Columbia

Aerial Spraying Banned in N.S. — The Nova Scotia cabinet bowed recently to environmental opponents and banned aerial spraying of herbicides this year.

The matter of aerial spraying has been referred to the Royal Commission of Forestry.

However, the government declined to ban ground application of the controversial chemicals 2,4-D and 2,4,5-T and some local community groups may yet appeal to the courts in an attempt to complete the ban.

The decision to revoke aerial permits issued to Nova Scotia Forest Industries, Scott Pulp and Paper Co. and Bowater Mersey Co. Ltd. on June 21 came after concerted opposition from environmental and community groups in the province.

Environment Minister Greg Kerr, making the announcement, would not elaborate on the cabinet decision saying: "It was a decision regarding questions on aerial applications. We're not going to get involved in other areas now."

(Chronicle Herald — July 9, 1982)
Halifax, Nova Scotia

Ban Surprises Pulp Co's. — Two spokesmen for pulp and paper companies involved in aerial spraying of herbicides on Nova Scotian woodlands say they are surprised by a recent announcement that the spraying has been banned in the province this year.

Barry Yuill, a reforestation officer with Scott Maritimes Ltd., said cabinet's decision to ban spraying was "purely political."

Another spokesman, Jack Dunlop of Bowater Mersey Pulp and Paper Ltd., said that the government was only being persuaded by a minority of people.

Mr. Dunlop, assistant woodlands manager, said in meetings with municipal councils in Western Nova Scotia the company met with a favorable response to its proposed aerial spray program.

However, Mr. Yuill said that attempts by his company to persuade community groups that the spraying was safe were unsuccessful.

"Their minds were made up and nothing I could say could persuade them," he said.

Mr. Yuill said that the dioxin level in the chemicals being used was not detectable at .005 parts per million.

(Chronicle Herald — July 9, 1982)
Halifax, Nova Scotia

A first in Quebec. — The Quebec government representatives of paper companies and the principal wood buyers have agreed on a series of measures to sell wood from private forests affected by the spruce budworm. The industry agreed to increase the volume of wood that it will buy by 270,000 cubic metres, and through Rexfor, the government is planning to finance the export of 300,000 cubic metres of this wood. Another 180,000 cubic metres could also be sold with assistance from the government if the sawmills agree.

(Le Soleil — July 7, 1982)
Quebec, Quebec

Ecological Accident at Rivière-du-Loup. — An accidental spill of 2,000 gallons of fenitrothion took place at the Ministry of Energy and Resources aerial spraying base located on Rivière-du-Loup airport land. The accident happened at 5:15 am on June 7 when the tanks of a DC-4, just back from its first spraying operation, were being filled. Fenitrothion is a non-systemic insecticide (it acts without being ingested) used by the Ministry of Energy and Resources in its fight against the spruce budworm.

The Ministry considers the current budworm epidemic to be very severe and on June 2, undertook a vast aerial spraying program in all of eastern Quebec. The spill took place at the beginning of the fifth day into the program. Mr. Louis Dorais told the Soleil yesterday that the program is now 65 percent completed.

Eight aircraft, including two Super-Constellations and six DC-4s, are used for the spraying. Two of these aircraft are rented from the United States. It was in one of these that a welded joint holding the walls of a compartment located under the floor and used to prime the aircraft's pumps gave way and caused the spill.

The insecticide immediately spread over the concrete which covers the ground at the base and some of it contaminated the ground near the supply area that is not covered with concrete. According to Mr. Dorais, 1,300 gallons were recovered and the rest that was in the aircraft and on the concrete was mopped up.

The spokesman for Energy and Resources also said that everyone involved in the clean-up was under medical supervision. Only one person had to be ordered to rest for a twenty-four hour period. This was a case of fatigue, however, and not poisoning or contamination.

Mr. Dorais mentioned that, following this accident, the decision was made to lighten the load of pesticide being used for spraying. The aircraft used can carry 2,800 gallons of insecticide. The quantity was reduced to 2,500 gallons.

The spill site is still being monitored to ensure that later contamination of the soil or ground water does not take place.

(Le Soleil — June 21, 1982)
Quebec, Quebec

**Recent Publications**

From the USDA Forest Service, Pacific Northwest Region, 319 S.W. Pine Street, Portland, OR 97208, you may order

Robert D. Harvey, Jr. 1982. "Loss assessment: western spruce budworm infestation on the Okanogan and Wenatchee National Forests." 36 p. (processed).

Nearby, at the Forest Service's Pacific Northwest Forest and Range Experiment Station, 809 N.E. 6th Avenue, Portland, OR 97232, reside copies of two new publications that will be of interest to modelers even though spruce budworm is not the subject. According to *PNW News*, the Station's in-house organ, these publications provide selected, typical yield tables from the DFSIM (Douglas-fir Simulator) computer program, and were written for forest managers who do not have easy access to computing facilities that would allow them to generate their own tables. The tables take into account the effects of initial spacing, precommercial and commercial thinning, and nitrogen fertilization. They can be used as aids in selecting management regimes, as guides to stocking control, and as a partial basis for estimating probable yields. The publications are

Robert O. Curtis, Gary W. Clendenen, Donald L. Reukema, and Donald J. Demars. 1981. "Yield tables for managed stands of coast Douglas-fir". PNW 81-144.

Robert O. Curtis, Gary W. Clendenen, and Donald J. Demars. 1981. "A new stand simulator for coast Douglas-fir: DFSIM user's guide." PNW 81-076.

For our Vermont readers, and others interested in questions related to deer habitat, another recent publication from PNW Station may be significant. Research Note PNW-368, "Effects of nitrogen and phosphorus fertilizers on deer browsing and growth of young Douglas-firs," answers the question "Do fertilizers increase deer browse?" The article, which compiles details from two areas studied in the Washington and Oregon Coast Range, states that nitrogen produced measurable responses in browsing of terminal shoots and affected growth of the trees in the first year, but only slight effects were noted 2 years after treatment. There was no detected response to phosphorus, and overall effects of applications of both materials were minimal. The authors note that heavily browsed trees may develop near-normal root systems and are capable of accelerated growth when released from browsing pressure.

The calculator crowd will be glad to hear about "Forestry programs for programmable calculators," a catalog available from the Cooperative Extension Service, Michigan State University, East Lansing, MI 48824. This catalog lists currently available forestry programs for programmable calculators, indexed by subject area, program title, and author. It also provides a brief description of each program, the make and model of calculator used, number of program steps used, and price. Among the subjects featured are silviculture, wildlife management, wood products, and forest soils and water.

From Forest Pest Management, State and Private Forestry, USDA Forest Service, Missoula, MT 59807, you may request a copy of

Lawrence E. Stipe and Alice K. Green. 1981. "A multiple ground application of acephate and carbaryl for protection of Douglas-fir cones from western spruce budworm." Rep. 81-22, 17 p. (processed).

The work of pioneering scientist Alex Shigo is highlighted in Bruce Shank's article "Shigo and his saw shed new light on tree health," in the June 1982 issue of *Weeds, Trees & Turf*, pages 28, 30, and 34.

Two reports concerning aerial spray technology have been released by Forest Pest Management, USDA Forest Service. "Recommended development plan for Aerial Spray Planning and Analysis System (ASPAS)," FPM 82-2, outlines a logical sequence in the development of the Forest Service-Cramer-Barry-Grim (FSCBG) spray model. The report, written by Ketron, Inc., under government contract, identifies knowledge gaps that must be filled if we are to increase pesticide efficacy and application efficiency. The second publication is FPM 82-1, "Spray drift of pesticides in mountainous terrain," written by the Environmental Systems Corporation, of Knoxville, Tennessee. It provides data of interest to land managers who plan and conduct aerial spraying operations. Included is a discussion of the atmospheric conditions that influence spray drift. Both reports can be ordered from USDA Forest Service, Forest Pest Management, 2810 Chiles Road, Davis, CA 95616,

The Newfoundland Forest Research Centre, Building 304, Pleasantville, St. John's, Nfld. A1C 5X8 has released Information Report M-X-208 by A.G. Raske and L.J. Clarke entitled "The status of the spruce budworm in Newfoundland in 1980."

From the Great Lakes Forest Research Centre, Box 490, Sault Ste. Marie, Ont. P6A 5M7, you may order

G.M. Howse, H.L. Gross, P.D. Syme, D.T. Myren, J.H. Meating, and M.J. Applejohn. 1982. "Forest insect and disease conditions in Ontario, 1981." Information Report O-X-339.

J.H. Meating, H.D. Lawrence, G.M. Howse, and J.R. Carrow. 1982. "The 1981 Spruce budworm situation in Ontario." Information Report O-X-343.

The Forest Pest Management Institute, Box 490, Sault Ste. Marie, Ont. P6A 5M7 has published the following:

O.N. Morris, M.J. Hildebrand, and A. Moore. 1982. "Response of the spruce budworm *Choristoneura fumiferana* (Clem.) to graded dosage rates and single versus double applications of *Bacillus thuringiensis* var *kurstaki*." Information Report FPM-X-53.

B.Z. Zylstra and A. Obarymskyj. 1982. "Experimental aerial applications of permethrin, carbaryl and chlorpyrifosmethyl for control of eastern spruce budworm, *Choristoneura fumiferana* (Clem.) in New Brunswick in 1980." Information Report FPM-X-56.

O.N. Morris. 1982. "Report of the 1981 cooperative *Bacillus thuringiensis* (B.t.) spray trials." Information Report FPM-X-58.

To get more information or to have your name added to the mailing list for the *Newsletter*, contact

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